Renova
Water Processes, LLC

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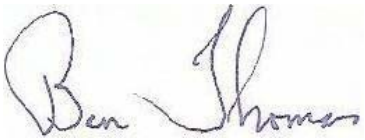
Take the dirtiest, filthiest water imaginable…

Let's start with raw sewage. That's bad stuff, but not bad enough. So, to the sewage let's add some used motor oil, and some stinky, rotten grease from a restaurant. Then pour in some gasoline, MTBE, some ethylene glycol (antifreeze), and some chlorinated solvents. Let's stir in some nitrate- and phosphate-rich fertilizer, and some pesticides. Mix in some soluble arsenic, chromium-6, radioactive isotopes, and perchlorate. Finally, let's put in some medical wastes and a few terrorist agents – some botulinum toxin (the most poisonous substance known), some anthrax spores, some chlorine-resistant microorganisms, some parasite cysts, poliovirus, HIV-contaminated blood, and of course, some flesh-eating bacteria. Mix well.

Now…imagine that you could run that mixture through a simple water-treatment system that (in about ten minutes) will remove the bad stuff, and produce crystal clear water…clean, pure water that meets all government standards…healthy water produced at less than one cent per gallon…drinking water that tastes as good or better than any bottled water available anywhere.

Welcome to the world of Renova Water Processes. Even if your water problem is worse than the mix above, we can help. Renova is a Master Broker/Agent for CES water treatment systems.



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OVERVIEW – CES WATER TREATMENT SYSTEMS

The Manufacturer: Custom Engineered Systems, Inc. (CES) designs and manufactures modular water treatment systems with flow rates ranging from 10 to 50,000 gallons per minute (14,400 to 72 million GPD). Larger systems require custom designs. CES systems remove chemical, physical, radiological, and biological contaminants (including bacteria, fungi, viruses, algae, and parasites) to produce treated water that exceeds the relevant regulatory criteria set by governmental authorities.

Summary of Treatment Processes used by CES: A CES system may be viewed as a series of treatment modules through which water is pumped at a specified rate. The treatment modules are based on well established technologies that are commonly used by traditional water treatment plants or systems. However, in developing its designs, CES evaluated the technical and operational limitations of these traditional treatment systems, and identified ways to make these processes more effective, less prone to failure, more cost-efficient, and easier to maintain.

CES's basic treatment strategy is elegantly simple:

1. Remove oil, debris, and large particles;
2. Convert dissolved contaminants into insoluble particles (i.e., form insoluble complexes, reduce metals, destroy soaps, phosphates and detergents);
3. Filter out particles larger than 300 microns (step clarifier);
4. Filter out particles larger than 25 microns (sand, bag filter or cartridge);
5. Filter out particles larger than 2 microns (diatomaceous earth or bag filter);
6. Remove soluble contaminants by adsorbing onto activated carbon;
7. Filter out particles larger than 1 micron; and
8. Disinfect.

The total treatment time (i.e., transit time through CES's modular treatment systems) is measured in minutes.

CES Process Modules: CES's modular design gives us great flexibility in combining the precise types, sequence, and intensity of treatments to remove the specific contaminants of interest. Your project may, or may not, require all of the process

modules discussed below. The specific CES treatment modules needed depends on the source of the waste water (such as, raw sewage, river water, groundwater, or industrial wastewater) and the intended use of the treated water (such as, drinking water; irrigation, or permitted discharge). CES's process modules include:

Remove Oil, Debris, and Large Particles

- **Heavy Solids Screening:** Uses a cylindrical cone screen or a rotary screen to remove large solids and debris from influent water (e.g., municipal sewage).

- **Oily Water Separator (Proprietary):** An ultra-compact proprietary device that removes oils, fuels, grease, sticky solids and grit from the continuously flowing water. If the amount of oil in the influent water is adequate, the separated oil can be discharged out of the treatment flowpath into a container for recovery or disposal.

- **Intake Filter:** Uses a standard-design sand filter or bag filter to remove particles larger than 5 microns in diameter.

Convert Dissolved Contaminants into Insoluble Particles

- **Mix Tank / Electro-flocculation (Proprietary):** Uses electricity to convert heavy metals, bioslime, phosphorus, nitrate, and other compounds into insoluble forms (particles). Small particles can be bound to small quantities of insoluble alum or polymer flocculants to form particle aggregates of sufficient size to be easily filtered out of the water. The electro-flocculation process also neutralizes acids, and kills pathogenic microorganisms and parasites.

Filter Out Particles Larger than 2 Microns

- **Step-Clarifier (Proprietary):** Removes 80 - 90% of suspended particles with a retention time of approximately 3 ½ minutes.

  Traditional systems use air, microbes, and large settling basins to remove solids. The effectiveness of such traditional systems are vulnerable to agitation during storm events, unscheduled releases to the environment as a result of flooding and overflow, as well as poisoning of the microbial treatment system by unanticipated toxicants entering the basin. A typical in-ground concrete clarifier is 150 feet across, takes 8 to 14 hours to effect partial settling of suspended particles, and does not work during rain storms.

  In contrast, CES's proprietary step-clarifier module is purely mechanical, effects clarification within a few minutes, is self-cleaning, and occupies less than $1/10^{th}$ the space of a standard settling basin of comparable daily flow.

- **Sand Filter / Diatomaceous Earth Filter / Bag Filter:** Uses pressure filtration to remove fine particles (2 - 5 microns in diameter). Collected particles are removed from the filters by backwashing, and collected in bag filters for disposal.

Adsorb Soluble Contaminants on Activated Carbon

- **Activated Carbon Filtration (Proprietary):** Filtration through activated carbon is a high-end treatment step that removes dissolved organic and inorganic chemicals by adsorption onto the surface of carbon particles. [Objective 6]

  Unlike traditional systems, the activated carbon in CES's commercial modules can be regenerated in-place. This offsets the expense of unloading spent granular carbon and shipping it to an off-site contractor for reactivation. CES's proprietary regeneration system does not require high temperatures (that destroy the porous structure and adsorption efficiency of the granular carbon, eventually requiring replacement of the carbon), and desorbed organic chemicals are destroyed in a catalytic converter (so that there are little or no air emissions). [Please be aware that CES offers this in-situ regeneration service only as part of a contracted maintenance agreement.]

Filter Out Particles Larger than 1 Micron

- **Polishing Filtration:** Uses a gradient polyester cartridge filter capable of removing particles as small as 1 micron (primarily fines from activated carbon). Depending on customer's needs, the treated water may be further treated or stored in a clearwater tank.

Reverse Osmosis to Remove Mineral Salts

- **Reverse Osmosis:** CES does not presently manufacture a reverse osmosis (RO) unit at this time, but its modular system can easily be coupled to a RO unit manufactured by another company. CES does this, for example, when a client wants to produce drinking water from a source that contains unacceptable levels of dissolved salts and minerals (e.g., seawater or brine). Because solids and other contaminants are effectively removed from the influent water by "pre-treatment" with the CES technology, the problems and replacement costs associated with fouling of the RO membrane are greatly reduced. Stated simply, while the CES system is not designed to remove ions like sodium and calcium from water, it will make dirty salt water into extremely clean salt water…adding RO makes salt water drinkable.

Disinfect Water

- **Disinfection by Catalytic Ozonation (Proprietary) / UV Treatment:** Although prior CES treatment modules are effective for disinfection (e.g., electro-flocculation and mechanical filtration), CES uses treatment by catalytic ozonation

and/or irradiation with ultraviolet (UV) light to ensure that no viable bacteria, fungi, algae, parasites or viruses remain in the water.

CES initially developed its water treatment technologies with a goal of providing a cost-effective, dependable and safe supply of water to communities around the world. Therefore, disinfection (and particularly the removal of parasites and cysts) was an important goal. While most microbiological agents are removable by simple filtration, viruses and other small pathogens and parasitic organisms can get through physical filters…and some of these agents are not killed by chlorination or by traditional ozonation systems.

The proprietary ozonation process used by CES produces ozone from the air, and produces a substantially higher concentration of ozone in the water than that achieved by other commercial ozonation systems. As a result, CES's catalytic ozonation process is estimated to be more than 5000 times more effective than chlorination for disinfection, and does not produce carcinogenic by-products. Ozonation, as you may know, is the disinfection method preferred in Europe, while many US water treatment plants use chlorine-based disinfectants (note: ozone quickly breaks down, leaving the water oxygen-enriched). It should also be noted that CES's proprietary ozonation process is effective at breaking down highly resistant chemical contaminants not fully removed by competitor's ozonation systems.

The germicidal UV irradiation system used by CES is powerful enough to achieve a total kill of all of the organisms listed by the US Centers for Disease Control, and may be used by CES as either a stand-alone alternative to ozonation and/or as a backup (fail-safe) treatment step.

CES water treatment systems remove specific contaminants by combining treatment modules of the right type and size, in the right sequence, and with flow rates that allow the necessary chemical reactions to go to completion.

Operating and Maintenance Costs: CES treatment modules have few, if any, moving parts. The parts of the system that require routine maintenance and/or replacement are items not manufactured by CES -- the water pumps (i.e., the main pump and pumps used to automatically backflush the filters), valves, filters, seals, and UV lamp. These are readily available from CES or from commercial vendors.

The energy requirements of CES water treatment plants are surprisingly low. Most of the electricity is consumed by the main pump and the catalytic ozonation process. The energy cost per gallon of water depends, of course, on the cost of a kilowatt hour of electricity, but even at US$0.10/KWH we estimate a produced cost of less than US$0.001 per gallon.

CES builds its commercial process modules with stainless steel to maximize durability. The units are self-cleaning, and minimal oversight is required for routine operation. In order to keep maintenance and repair costs to a minimum, CES uses quality commercial pumps, valves, filters, seals, and UV lamps.

For large commercial units, CES provides quarterly maintenance servicing on a contract basis, but please see note above (concerning in situ reactivation of spent carbon).

Photographs of a CES Water Treatment System: Below are photos of our trailer-mounted RF-100 plant, that is capable of producing up to 144,000 gallons of drinking water per day from a non-salty freshwater source. These photos were taken at a demonstration held at the Snapfinger Sewage Treatment Plant near Atlanta, Georgia. The influent water was raw sewage to which CES added gasoline, motor oil, antifreeze, and dandruff shampoo. The water came out the other end in about 10 minutes and exceeded all established standards for drinking water (see attached analytical data). Please keep in mind that CES systems are optimized to remove specific contaminants from waste water. The analytical results from the modules and reaction conditions used for this demonstration may underestimate the effectiveness of CES systems for the contaminant(s) of your interest.

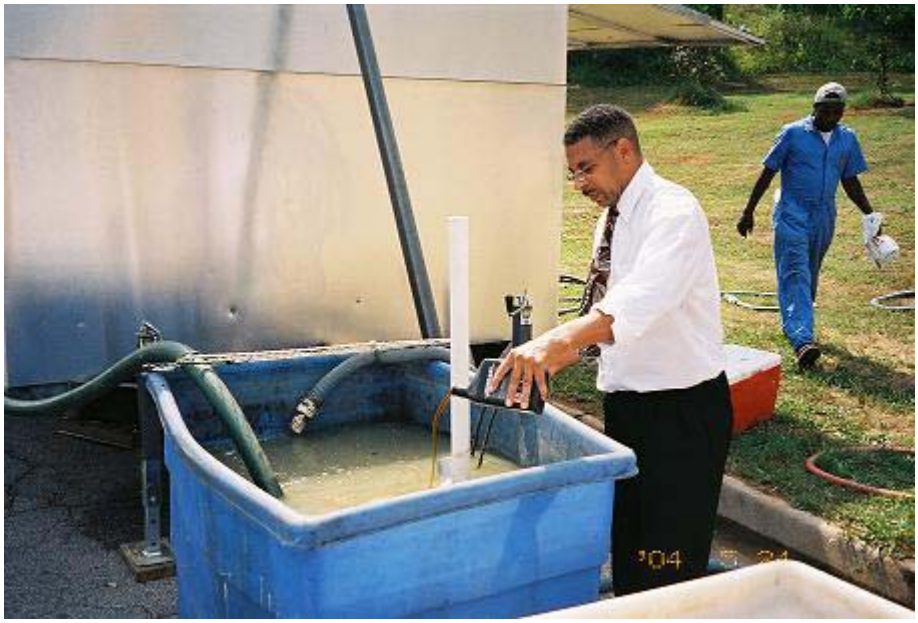

Figure 1: Adding motor oil to raw sewage. The mix of sewage, gasoline, motor oil,antifreeze (ethylene glycol), and a dandruff shampoo was then run through the RF-100 system.

Figure 2: This portable CES water treatment plants can be viewed as a series of process modules through which water is pumped at a set flow rate. While the processes used are well known and commonly used in traditional water treatment plants, CES has reevaluated each with regard to ways to make each process step more effective, less prone to failure, more energy and cost efficient, and easier to maintain. CES plants are extremely compact -- the RF-100 unit is small enough to fit on an 8 x 20-ft trailer, yet treats a freshwater influent at a flow rate of up to 144,000 gallons per day (GPD). The flow rate for treating raw sewage is reduced to approximately 50,000 GPD because of the high particle load of raw sewage. Assuming an average water usage in the U.S. is 5 GPD per person for drinking and cooking, this portable unit will treat enough freshwater to provide emergency drinking water for a community of 28,000 people.

Figure 3: Drinking water produced from raw sewage after 10 minutes of treatment. CES water treatment systems do things that the competition can't…and because they are modular, an entire plant can be designed and built in a matter of weeks, rather than years.

Analytical results from the demonstration at the Snapfinger Sewage Treatment Plant are attached.

Certified Lab Results -- 25 May 2004

Technology Demonstration at Snapfinger Sewage Treatment Plant (DeKalb County, Georgia)

Summary of Data Tables from Advanced Chemistry Labs, Inc. (Atlanta)

Equipment: CES RF-100m System at 36 GPM

Influent: Raw sewage to which gasoline, antifreeze (ethylene glycol), Head & Shoulders shampoo, and rat poison (D-Con) were added.

		ACL-45162	ACL-45164	ACL-45163		
Analyte (Prep Method/Analytical Method)	**Units**	**Raw Sewage (Before Treatment)**	**Sewage+Adds (Before Treatment)**	**Sewage+Adds (After Treatment)**	**Drinking Water Criterion**	**Type**
Total Petroleum Hydrocarbon (5030B/8015B)						
Gasoline Range Organics - C6 to C10	mg/L	BQL (< 0.20)	2760	BQL (< 0.20)	~	
Diesel Range Organics - C10 to C28	mg/L	3.37	--- [2]	0.36	~	
Oil & Grease (1664)	mg/L	23	--- [2]	BQL (< 10)	~	
Volatile Organic Compounds (5030B/8260B)						
Acetone	ug/L	161	BQL (< 200,000) [1]	BQL (< 100)	~	
Benzene	ug/L	BQL (< 5)	41,800	BQL (< 5)	5	Primary
Ethylbenzene	ug/L	BQL (< 5)	72,000	BQL (< 5)	700	Primary
Ethylene Glycol (8015B)	(mg/L)	BQL (< 10)	349	BQL (< 10)	~	
MTBE	ug/L	BQL (< 5)	12,000	BQL (< 5)	~	
Naphthalene	ug/L	BQL (< 5)	17,800	BQL (< 5)	~	
n-Propylbenzene	ug/L	BQL (< 5)	24,300	BQL (< 5)	~	
Styrene	ug/L	11	BQL (< 10,000) [1]	BQL (< 5)	100	Primary
Toluene	ug/L	21	321,000	BQL (< 5)	1,000	Primary
1,2,4-Trimethylbenzene	ug/L	BQL (< 5)	150,000	BQL (< 5)	~	
1,3,5-Trimethylbenzene	ug/L	BQL (< 5)	45,500	BQL (< 5)	~	
m & p-Xylenes	ug/L	BQL (< 10)	268,000	BQL (< 10)	10,000	Primary
o-Xylene	ug/L	BQL (< 5)	98,600	BQL (< 5)	10,000	Primary
Semi-Volatile Organic Compounds (3510C/8270C)						
Bis-(2-ethylhexyl)-phthalate	ug/L	33	--- [2]	BQL (< 10)	~	
Total Metals (200.7/245.1)						
Aluminum	mg/L	5.34	--- [2]	0.06	0.2	Secondary
Antimony	mg/L	BQL (< 0.006)	--- [2]	BQL (< 0.006)	0.006	Primary
Arsenic	mg/L	BQL (< 0.010)	BQL (< 0.010)	BQL (< 0.010)	0.010	Primary
Barium	mg/L	0.132	--- [2]	0.073	2.000	Primary
Beryllium	mg/L	BQL (< 0.004)	--- [2]	BQL (< 0.004)	0.004	Primary
Cadmium	mg/L	BQL (< 0.005)	--- [2]	BQL (< 0.005)	0.005	Primary
Calcium	mg/L	41.1	--- [2]	45.9	~	
Chromium	mg/L	BQL (< 0.010)	BQL (< 0.010)	BQL (< 0.010)	0.100	Primary
Hexavalent Chromium (7196)	mg/L	BQL (< 0.010)	--- [2]	BQL (< 0.010)	~	
Copper	mg/L	0.509	--- [2]	BQL (< 0.020)	1.300	Secondary
Iron	mg/L	4.83	--- [2]	0.34	0.3	Secondary
Lead	mg/L	0.044	--- [2]	BQL (< 0.010)	0.015	Primary
Magnesium	mg/L	3.03	--- [2]	2.47	~	
Manganese	mg/L	0.236	--- [2]	BQL (< 0.050)	0.05	Secondary
Mercury	mg/L	BQL (< 0.0005)	--- [2]	BQL (< 0.0005)	0.002	Primary
Nickel	mg/L	BQL (< 0.020)	--- [2]	BQL (< 0.020)	~	
Phosphorus (365.2)	mg/L	7.47	--- [2]	0.22	~	
Potassium	mg/L	12.9	--- [2]	12.6	~	
Selenium	mg/L	BQL (< 0.040)	0.366	BQL (< 0.040)	0.0500	Primary
Silica, Dissolved (Si) (200.7)	mg/L	4.9	--- [2]	5.2	~	
Silver	mg/L	BQL (< 0.010)	--- [2]	0.015	0.1	Secondary
Sodium	mg/L	57.8	--- [2]	62.3	~	
Strontium	mg/L	0.155	--- [2]	0.206	~	
Thallium	mg/L	BQL (< 0.010)	--- [2]	BQL (< 0.010)	0.002	Primary
Zinc	mg/L	0.710	--- [2]	0.035	5.000	Secondary
Anions						
Residual Chlorine (330.3)	mg/L	BQL (< 1.0)	--- [2]	BQL (< 1.0)	MRDL = 4.0	Primary
Cyanide (335.4)	mg/L	BQL (< 0.020)	--- [2]	BQL (< 0.020)	0.2	Primary
Fluoride (340.2)	mg/L	1.27	--- [2]	1.27	2.00	Secondary
Nitrogen, Nitrate (353.2)	mg/L	BQL (< 0.10)	--- [2]	BQL (< 0.10)	10.00	Primary
Nitrogen, Nitrite (353.2)	mg/L	BQL (< 0.10)	--- [2]	BQL (< 0.10)	1.0	Primary
Nitrogen, Ammonia (350.2)	mg/L	15.0	--- [2]	4.2	~	
Sulfate (375.4)	mg/L	13.30	--- [2]	52.0	250	Secondary
Misc. Parameters						
Alkalinity (CaCO3) (310.1)	mg/L	175	--- [2]	99	~	
Alkalinity-Phenophthalein	mg/L	BQL (< 2)	--- [2]	BQL (< 2)	~	
COD (410.4)	mg/L	619	--- [2]	35	~	
Color-Apparent (SM2120)	Pt-Co	4	--- [2]	BQL (< 1)	~	
Color-True (SM2120)	Pt-Co	3	--- [2]	BQL (< 1)	15.00	Secondary
Conductivity (120.1)	µmhos/cm	481	--- [2]	499	~	
Fecal Coliform (SM9222D)	# / 100 ml	360,000	--- [2]	BQL (< 2)	~	
Hardness (SM2340B)	mg/L	115	--- [2]	125	~	
pH (150.1)	pH Units	6.9	--- [2]	6.9	6.5-8.5	Secondary
Total Suspended Solids (160.2)	mg/L	314	--- [2]	BQL (< 5)	~	

[1] The laboratory had to dilute this sample 2000-fold in order to get hydrocarbon concentrations within linear portion of their standard curve; Practical Quantitation Limits (PQLs) of all analytes were affected accordingly. "BQL" = Below Practical Quantitation Limit; also restated explicitly as (< PQL). "---" = Not Analyzed "~" = No drinking water criteria. "Primary" = National Primary Drinking Water Standard (EPA). "Secondary" = National Secondary Drinking Water Standard (EPA).

[2] See analysis of untreated raw sewage before addition of test contaminants.